RESEARCH DEPARTMENT

Congress on Methods of Sound Recording and their Extension to the Recording of Information— Paris, April 5th – 10th, 1954

Report No. C.083

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THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

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1. INTRODUCTION.

This Report contains notes on some aspects of the Congress which I attended recently in Paris. The proceedings, which were of great interest, can be divided into three parts:

(1) the reading and discussion of technical papers,

(2) visits to various technical installations and factories,

(3) an Exhibition of sound recording and associated equipment.

2. READING AND DISCUSSION OF PAPERS.

A great variety of papers was presented, mainly by French authors. A proportion of the papers were not concerned with original work but consisted of reviews or historical surveys of material which is known. Some of the more interesting papers were read in the section on magnetic recording. I do not mean more interesting to me only, but more interesting in a general sense, for an increasing use of magnetic recording in computors and other storage applications and the investigations of television and high-frequency recording which are being pursued in various laboratories tended to give this section an atmosphere of greater novelty. It is obviously not of value to give a résumé of, and comments on, every paper I heard, but I have dealt with individual contributions where they may be of general interest.

2.1. General Papers.

A paper of some interest from the broadcasting point of view was that given by M. Angles D'Auriac on "Use and Trends of Recording in Both Broadcasting and Television". This consisted mainly of an interesting collection of statistics on the use of recording in the Broadcasting Services of Europe, the Commonwealth and some Latin-American countries, based on information collected by the European Broadcasting Union. These statistics show that:

i. the B.B.C. transmits a higher percentage of live programme and a smaller percentage of recorded programme than any other Broadcasting Service,

ii. the percentage of disk recording (as compared with tape recording) used by the B.B.C. is vastly in excess of any other Broadcasting Service.

The latter fact excited some comment, of course, as it did in the Hamburg Recording Congress some two years ago. When the speaker was questioned as to the reason for this he read the statement made by Davies at Hamburg and then passed the question over to me for elaboration. I repeated the arguments as we all know them and added that although our use of tape would no doubt increase, our disk output must remain large not only for our own purposes but because of the Transcription Service. I said that users of the B.B.C. Transcription Service will, for a long time, require disk records, for however willing we are to distribute tape, they may not be willing to receive it, having regard to the disk equipment in which they have so much capital tied up.

2.2. Magnetic Recording—Operational.

F. Gallet of the R.T.F. gave a good summary of the origins of noise in magnetic recording and methods of measuring them. This contained a lot of information which he had gained in his development of the magnetic tape testing equipment used by the R.T.F. for the checking and classifying of tapes before putting them into service. He also gave a description of this equipment which tests eight tapes at once. The R.T.F. have manufactured two of these quite expensive machines and I saw one more in the process of manufacture. The main tests carried out are those for sensitivity and uniformity along the reel but two tapes in every eight are also tested for modulation noise. Selected tapes are also tested for mechanical properties. On the basis of sensitivity and uniformity the tapes are divided into three categories before being put into service. The tolerances defining the three categories are very close together, however, and I find it difficult to believe that recording levels are so closely controlled in service for the classification really to have much significance.

H. Schiesser, representing the German Broadcasting Services, read a paper on "New Magnetic Recording Equipment used by the Broadcasting Companies of the Federal German Republic". This was really a "flag-waving" effort to describe all the clever things they were doing. He re-asserted their claims to the rotating magnetic head (which they used during the war for frequency compression) which has recently been "re-invented" by a group of Americans. In addition he gave a description of an artificial reverberation machine which they are at present making, which is similar, in general principles, to that which we have in service. He was at pains to refer to the B.B.C. equipment, which we demonstrated to C.C.I.R. last October, and cannot be criticised on this account. On the other hand, it is obvious that the Germans were very anxious to get something into print about this and I suspect their machine is not yet finished. In his description Schiesser talked vaguely of feedback from three heads, two of them very early in the chain. When I asked him how they had overcome colouration difficulties, which are fundamental to the procedure of feeding-back at high level, he was unable to make any comment and said they would probably be able to give more information in two months. I can only assume that multiple feedback, which looks all right on paper, has not been seriously tried by them yet. Feedback taken too early was, in our experience, a retrograde step in both the tube and magnetic system, because it was not possible to feed back a sufficient level to make any difference to the decay "picture" before colourations were noticeable. In this respect the forthcoming Research Department paper on Artificial Reverberation will be timely for it will give some space to the fundamental difficulties and their causes. No mention of any of these was given in the German description, the whole thing appearing too easy for words.

2.3. High Frequency Recording.

The afternoon of the 8th April was devoted to four papers on high-frequency recording. One, by J. Borne, was concerned with the effect of recording head characteristics on high-frequency response but was not of great originality being mainly a re-write of work already published by Westmijze. The other three papers, which were concerned with the recording of television signals on a magnetic medium, are discussed in the following sections.

a. A lecture on Video Tape Recording by J.T. Mullen of Bing Crosby Enterprises Inc. This was a lecture read in French (not by Mr. Mullen) which described the Bing Crosby multi-track system just as we know it. No questions were called for in the reading of this paper.

b. A System of Recording and Reproducing Signals by C.G. Mayer of R.C.A. This described the R.C.A. system in essentially the same terms as are contained in the Press hand-out which we have in our possession. It was useful to hear it first hand and to hear the relative emphasis placed on the various difficulties. Points of particular interest, together with my comments, are as follows:

i. The R.C.A. expect their system to be in commercial use within two years and consider that they have surmounted the worst problems. It can be applied to monochrome (one video track, ¼ in. tape) and colour television (four video tracks, ½ in. tape). The advantages of immediate playback and rapid distribution were very great.

ii. They realise that their tape speed is excessive and stated that they are trying to reduce it. They expect to be able to get down to 200 in./sec. but no mention was made of 100 in./sec.

iii. The tape transport must be very carefully designed to eliminate jitter of the picture due to speed inconstancy. Great attention is paid to the maintenance of constant tension in the tape and a servo-system is employed to keep this (and the speed) constant.

iv. The highest frequency recorded is 3½ megacycles and, at the tape speed employed, this represents a wavelength of 2½ microns. The gap in the R.C.A. heads was stated to be less than this value so that alignment of the heads becomes of paramount importance. Mr. Mayer stated that the frequency response of the heads was smooth, with reasonable signal-to-noise ratio, up to 3½ megacycles. The physical configuration of the head is very important in maintaining the correct frequency response and "constant impedance over the frequency band", and particular attention must be paid to the shape of coils, shields and mountings. At the tape speed employed the head must have good wearing properties, be stable under varying conditions of temperature and humidity and, in the colour applications, its physical size must be quite small. It should be noted that he made no claims that the system was equalised up to 3½ megacycles and I do not think it reasonable to suppose that it could be in a system so straightforward in principle (if not in practice).

v. In his lecture Mayer stated that normal tape is used and the dimensions which he gave for it certainly conform to the accepted standards.

I had an opportunity of talking to Mr. Mayer privately, when I expressed doubts as to the quality of short-wavelength recording and reproduction having regard to the average particle size (1μ) in normal tape compared to the shorter wavelengths on the tape ($\sim 2\frac{1}{2}\mu$). Severe amplitude modulation of high frequencies must result from varying effective separation, for the signal falls off at 55 db/wavelength separation. He admitted the point and went on to say that they had, in fact, started a very extensive programme on the manufacture, smoothing and polishing of tapes in order to overcome the effects of which we were speaking. This would lead me to suppose that the effects are much more serious than admitted and, in fact, their high-frequency response is limited, amongst other factors, by the surface condition of the tape.

vi. A D.C. erase system is employed. This information was quite new and is very surprising. In the R.C.A. system the bias and A.C. erase currents must, of course, have a frequency of about 8 megacycles if 3½ megacycles are being recorded. We have always wondered how, at such a frequency, they could get sufficient power into the heads. In the case of the erase head the answer is, obviously, that they do not, for they must have been forced to adopt a D.C. erase system. The effect of this on the signal-to-noise ratio in the upper frequency band must be severe. In our frame-delay system we are trying to get away from D.C. erase and use an A.C. system. D.C. erase, coupled with the effective separation loss (see v), must make their response over 2 megacycles very poor.

vii. Mr. Mayer stated that the recording of sound at a tape speed of 360 in./sec. is much more difficult than at normal speeds, owing to effects which result from the very long wavelengths on the tape. This agrees with our findings in the work on high disk-speeds in the Artificial Reverberation Machine, where the physical dimensions of heads allow secondary gaps, etc. We have been able to equalise our frequency response within a satisfactory tolerance without fundamental departure from normal technique. However, since the R.C.A. tape speed is some 3½ times as great as our disk speed their difficulties are obviously greater. They have, therefore, adopted a system of amplitude modulation of a 150 Kc/s carrier.

viii. In the question time which followed, the speaker was asked, in view of the (equalisation) difficulties which arose in the audio recording, how the same difficulties were surmounted in the recording of that part of the television spectrum which lies between 0 and 15 Kc/s. He replied that the point was "well taken" but made no attempt to answer it stating that he was only there to describe a demonstration which had been given in the R.C.A. laboratories and not to tell everybody else how to do it. I suspect the answer to be that the effect is accepted, for, providing adequate synchronising signals are available, the television picture and the eye may be rather more tolerant of low frequency effects of this sort than is the ear. In any event they can presumably do without much video signal below 5 Kc/s (by use of D.C. clamping, etc.), whereas this is the essential region required in the audio signal.

c. A demonstration by Professor G.A. Boutry entitled "Presentation of a Television Picture Recording and Reproducing Experiment". This was essentially similar to the demonstration which Research Department gave recently to the Scientific Advisory Committee. A French Television Service Transmission was received, using an aerial on the roof of the building, and the video signal, after extraction from the carrier, was applied to a recording amplifier feeding a single head adjacent to the edge of a coated wheel. The frequency band claimed was about ½ Mc/s wide. The wheel was smaller than ours but rotated at a higher speed. The demonstration was purely experimental and did not seem to be intended for a frame-delay as we envisage the system. The disk was not rotating accurately in synchronism with the mains for the driving system consisted of a separately mounted motor driving the disk by means of a band and pulley arrangement. The expected troubles with frame synchronisation were obvious. When in synchronism the picture seemed to have less contrast range than we have been able to obtain and the magnetic coating appeared to be rather less uniform than we have obtained as was demonstrated by the presence of very dark patches over the picture. Nevertheless, as we found in our demonstration, the result was surprisingly good. Very sensibly, the programme chosen for the demonstration was part of a Newsreel and part of a Puppet Show and no test cards were shown. As far as I can gather R.C.A. have never demonstrated a test card either. As we know, the system can show up badly in dealing with a test card whilst still being capable of giving an adequate account of suitable programme material.

3. VISITS TO TECHNICAL INSTALLATIONS AND FACTORIES.

Two afternoons were devoted to visits to technical installations and factories, on the first of which I visited the Pyral Factory and on the second, the Centre Pierre Bourdon, the French Broadcasting Studio Centre in Paris. I also made private arrangements to visit that part of the R.T.F. which corresponds approximately, to our Designs Department and R.M.U. and also to visit the Film Studios of the Paris Studio Cinema.

3.1. Visit to Pyral Factory.

In this visit we were shown mainly the manufacture of disk records, their inspection and their testing. Pyral disks are, generally speaking, a very good product and it was interesting to see how few people were needed in their production. The disk coating and drying plant seemed to be very well designed and the whole factory very efficiently run. As far as I could see the factory was working at half capacity because only one of its two disk production lines was in use. We were not shown tape manufacture and the Managing Director stated that this was a matter of policy since many of the processes involved were commercial secrets. The alternative visit on this afternoon was to the Kodak-Pathé Factory and I understand that there, too, the visitors were not shown any aspect of tape manufacture. It is very difficult for us, even in England, to get a look at tape manufacture.

3.2. Visit to Centre Pierre Bourdon.

This Centre is extremely lavish in matters of space and decoration. The generous amount of recording equipment associated with each studio was very noticeable, and I suppose this reflects the high percentage of recorded programme which the French transmit. As far as I could gather, most plays were transmitted as recordings, and various top-rank stage stars were working in the studio in the "out-of-theatre" time. The recording machines, both disk and tape, were of Tolana manufacture. The disk equipment was extremely primitive and a specimen disk which was played to us to illustrate some point was a poor advertisement. I was amused to see in the largest Drama Studio a series of painted scenes hinged on the walls. Apparently a suitable scene is swung into place for each act or scene in the broadcast play. Although this refinement is obviously lost on the listeners, it is claimed that it makes the actors feel more at home so that they put their heart into it. Scenes available seemed to range from the very romantic to the horrific.

3.3. Visit to R.T.F. Technical Centre.

On my visit to the Technical Centre I was shown the whole procedure by which R.T.F. check tapes and develop and make the machines for this purpose. In addition to the machine described in 2.2 they have also developed an automatic machine for testing distortion, frequency response, and accidental-printing levels. They have also elaborate apparatus for testing stretch under various tensions and for measuring the curvature across a tape under tension. The latter measurement might be of some interest in connection with effective separation and high-frequency response. Other recording activities of this Section are the renovation of head units including the setting of alignment (by optical means). It is of interest that they do not attempt to re-grind heads for service but always install new ones and use up the worn heads on the tape-testing machines. I have doubts about the value of a tape-test carried out using a very worn head.

3.4. Visit to Paris Cinema Studios.

In this visit I was able to inspect the magnetic recording activity associated with the making of films. This is being carried out on 35 mm. coated film using American equipment. As in all modern practice, the actual recording machines were installed in a room remote from the sets, the actual mixing and level control being carried out on a portable desk behind the set. I was also able to inspect, in some detail, the procedure by which foreign films were dubbed with the French language. They have certainly got this down to a fine art with the aid of the magnetic recording system. The process is carried out in a projection studio where a closed loop of the optical film (no sound), about some three minutes in length, is shown on the screen in front of the actors. Synchronously with this, a magnetic loop is run through the sound recording machine and a previously prepared transcript, in normal hand-writing, of the equivalent French dialogue is projected under the picture on the screen. Intensive rehearsal is then carried out by the actors who read off the dialogue in synchronism with the lip movement on the film, the same scene coming round and round until everyone feels ready for the actual sound recording. At this stage the magnetic loop is actually recorded and then played back. If the producer is satisfied they proceed to the next scene. If he is not satisfied the magnetic loop is erased and they try again. The use of the magnetic system makes this process quick and cheap and apparently they are able to dub a full-length film by this means in between 4 and 6 days. There are, apparently, a group of actors and actresses who make their living entirely in doing this work. I do not know whether such a process might ever be of interest to the Television Service, but with practice, it can certainly be made quick and fairly easy.

4. EXHIBITION OF SOUND RECORDING AND ASSOCIATED EQUIPMENT.

In the exhibition of sound recording and associated equipment, which formed part of the Congress, most of the leading French firms were represented. There was also representation from Germany, Holland (Phillips) and the United Kingdom (Grampian Reproducers and Truvox Ltd.). A few American products were also to be seen through the medium of local agents.

Nordwest Deutscher Rundfunk had a large stand on which they were demonstrating several recording machines of recent design and the available Agfa tapes. Among the more interesting of the machines was a Portable Recorder made by H. Maihak. AG. Hamburg, and known as the Reportofon model, MMK3. This was a battery or mains-driven portable, having a tape speed of 7½ in./sec. and a playing time of 7½ min./reel. The frequency response claimed was from 60-6,500 c/s with a tolerance of ± 2 db. The re-wind was carried out by hand and the total weight of the equipment was 7·5 kilograms. The battery for use in the machine was contained within the single case but there was the very useful alternative facility of using mains supply if available. In addition the apparatus could be plugged into the mains overnight so that a small built-in charger replenished the batteries. A "cut-out" stopped the charging when the battery was fully charged. A single meter in the equipment allowed recording levels, voltages and currents to be measured as required. The whole thing was extremely simple to operate and seemed adequately fool-proof.

The R.T.F. demonstrated their tape-testing machine which I have described in a previous paragraph.

Rocke International, Ltd., demonstrated a Reverberation Machine made by the Audio-Instrument Co. of New York. The delay was obtained in this apparatus with a loop of magnetic tape and two models were available having either five or seven heads. The tape speed was fairly slow and the head responses were, consequently, widely separated in time. The people on the stand had not the remotest idea how it all worked but they were able to give a demonstration of the effect of putting a microphone feed into the system. The performance, as I heard it, would certainly not come up for serious consideration in the B.B.C.

Among the more interesting exhibits was a magnetic drum store for digital computors, marketed commercially as a separate unit, together with its associated circuits. It is very interesting that there is a demand for such a thing to which organisations can add their own external electronics as required. The design did not pretend to anything exceptional in the way of recording technique, the equivalent operational frequency being about 100 Kc/s. The layout seemed to be very similar to that in the Manchester University computor for the drum was running with its axis vertical with a motor built inside it. The drum had a magnetic-oxide coating, however, and the heads employed were very different from those at Manchester University, the cores being of ferroxcube set in something like "Araldite".